the image enhancing gas (and its anticipated contaminants being transported. As above, such properties as corrosiveness and leak potential will be important in the selection of the valve and conduit materials. Typically, the conduits and valves will be formed of stainless steel (such as Type 316L) or another resistant alloy and will be all-welded; the fittings will commonly be high integrity compression or face seal fittings. Leak potential will be particularly significant when He^3 is the image enhancing gas. It is well known that helium is uniquely difficult to restrain within a system, and some leakage of He^3 is to be expected. However, in view of the rarity of He^3 and its non-recoverable loss once having leaked from the system, system leakage potential should be kept to the minimum practical.

The pressure ranges in the various parts of the system are not critical but will be such that the vacuum or elevated pressure levels selected will be highly efficient in providing the feed gas to the hyperpolarization unit **50** and in moving the exhalant-contaminated gas through the decontamination steps either under vacuum or pressure. Typical of the usable ranges are superatmospheric pressure up to about 250 psig (1725 kPag] through subatmospheric down to about 100 mTorr (0.01 kPag).

The image enhancing gases to which this system will be applicable are those such as He^3 and Xe^{129} which are either rare or expensive or both. For some imaging procedures it may be that the image enhancing gases used are neither rare nor expensive, such as common isotopes of major atmospheric gases. For such gases, simply venting from a unit **50** and emptying of bag **56** to the atmosphere after the imaging procedures have been completed is perfectly acceptable. Such gases are of no environmental hazard and can be readily recovered from atmospheric air by common and inexpensive air separation procedures. While such gases could of course be recovered by the present process, is unlikely to be economically justifiable to do so. On the other hand, the present process is not to be considered to be limited only to He^3 and Xe^{129}, but rather will be applicable for use with substantially all image and handling enhancing gaseous isotopes which may be identified in the future and for which application of this process for recovery and purification can be justified economically.

It will also be seen that the present invention is well suited to being automated to any degree desired. A computer **102** and the appropriate software may be used to control the opening and closing of various valves such as **24**, **46** and **70**, operation of the compressor **96/96'** and pump **66**, the various decontamination units **72**, **78**, **88** and **94**, and the hyperpolarization unit **50**, all as graphically indicated by the dotted lines **104** in the FIGURE. Other equivalent connections not shown can operate other valves in the system as well as making determinations such as the quantity of gas present in tank **20**. Thus, for instance, discharge of contaminated gas from bag **57** into line **64** can be recognized by a pressure sensor **106** in line **64**, which sends a signal through line **108** to computer **102**. Suitable software will then start a sequence in which the various valves, pump, compressor and decontamination units are opened and closed in the proper sequence and started and stopped at appropriate intervals, so that decontamination of the image enhancing gas can be accomplished and the purified gas can be collected in tank **20** for reuse. Overheating in getter **94** likewise can be detected by temperature sensor **93**, which also signals through line **108** to microprocessor **102**, which responds by control of orifice **97**. Such control and operating functions are all well within the knowledge of those skilled in the art and the capabilities of commercially available computer systems and software. The operator of the present system can therefore select systems and software to automate as much or as little as desired of the system.

It will be evident that there are numerous embodiments of the present invention which, while not expressly described above, are clearly within the scope and spirit of the present invention. The above description is therefore to be considered exemplary only, and the scope of the invention is to be determined solely by the appended claims.

We claim:

1. A method for recovery and purification of a gas used to enhance a medical process, which comprises:

a. passing said gas to said medical process and therein using said gas for enhancement of said process, use in said process also causing gaseous or liquid contaminants including water vapor, carbon dioxide, oxygen or nitrogen, to become incorporated into said gas;

b. collecting at least a portion of thus-contaminated gas;

c. determining which said gaseous or liquid contaminants are contained in said gas;

d. drying said contaminated gas to reduce said water concentration in said contaminated gas to not greater than 10 ppm, if said contaminated gas contains a water concentration;

e. contacting said contaminated gas with a carbon dioxide absorbent to reduce said carbon dioxide concentration to not greater than 10 ppm, if said contaminated gas contains a carbon dioxide concentration;

f. contacting said contaminated gas with an oxygen absorbent to reduce said oxygen concentration to not greater than 1 ppm, if said contaminated gas contains an oxygen concentration;

g. contacting said contaminated gas with a nitrogen getter to reduce said nitrogen concentration to not greater than 1 ppm, if said contaminated gas contains a nitrogen concentration;

h. reducing other non-noble gaseous contaminants to not greater than 10 ppm, if said contaminated gas contains said other non-noble gaseous contaminants; and

i. collecting said gas after such decontamination for recycle to said medical process and subsequent reuse therein.

2. A method as in claim **1** wherein said gas is selected from a group consisting of an isotope of helium, xenon, carbon, fluorine and phosphorous.

3. A method as in claim **2** wherein said isotope of helium comprises He^3.

4. A method as in claim **2** wherein said isotope of xenon comprises Xe^{129}.

5. A method as in claim **2** wherein said isotope of carbon comprises C^{13}.

6. A method as in claim **2** wherein said isotope of fluorine comprises F^{19}.

7. A method as in claim **2** wherein said isotope of phosphorus comprises P^{31}.

8. A method as in claim **1** where said contaminant water concentration in said contaminated gas is reduced to not greater than 100 ppb.

9. A method as in claim **8** where said contaminant water concentration in said contaminated gas is reduced to not greater than 10 ppb.

10. A method as in claim **1** where said carbon dioxide concentration in said contaminated gas is reduced to not greater than 100 ppb.

11. A method as in claim **10** where said contaminant water concentration in said contaminated gas is reduced to not greater than 10 ppb.

12. A method as in claim 1 where said oxygen concentration in said contaminated gas is reduced to not greater than 100 ppb.

13. A metho d as in claim 12 where said oxygen concentration in said contaminated gas is reduced to not greater than 10 ppb.

14. A method as in claim 1 wherein said other non-noble gas eous contaminants are selected from a group consisting of hydrogen, a hydrocarbon, a nitrogen oxide and ozone.

15. A method as in claim 1 further comprising hyperpolarizing said gas prior to passage of said gas to said medical process.

16. A method as in claim 15 wherein said gas prior to said hyperpolarization is under superatmospheric pressure.

17. A method as in claim 16 wherein said medical procedure in which hyperpolarized gas is used comprises medical imaging.

18. A method as in claim 17 wherein said medical imaging procedure in which hyperpolarized gas is used comprises magnetic resonance imaging.

19. A method as in claim 18 wherein said gas is selected from the group consisting of helium and xenon isotopes.

20. A method as in claim 19 wherein said isotope of helium comprises He^3.

21. A method as in claim 19 wherein said isotope of xenon comprises Xe^{129}.

22. A method as in claim 15 wherein following hyperpolarization said gas is collected in a first gas-tight container from which said gas is inhaled by said patient during said medical imaging process, and following medical imaging of said patient said gas is subsequently exhaled by said patient into second gas-tight container, said gas exhaled being contaminated with respiratory gases and vapors simultaneously exhaled by said patient, following which said contaminated gas in said second container is withdrawn from said second container under subatnospheric pressure and passed for decontamination in steps d–h.

23. A method as in claim 22 further comprising, prior to said decontamination, compressing thus-decontaminated gas and purifying and storing said decontaminated gas under superatmospheric pressure for said recycle and reuse.

24. A method as in claim 22 further comprising, following said decontamination, compressing thus-decontaminated gas and storing said decontaminated gas under superatmospheric pressure for said recycle and reuse.

25. A method as in claim 22 wherein residual gas in said first container not inhaled by said patient is withdrawn from said first container under substmospheric pressure and also passed for decontamination in steps d–h.

26. A method as in claim 25 further comprising, prior to said decontamination, compressing thus-decontaminated gas and purifying and storing said decontaminated gas under superatmospheric pressure for said recycle and reuse.

27. A method as in claim 25 further comprising, following said decontamination, compressing thus-decontaminated gas and storing said decontaminated gas under superatmospheric pressure for said recycle and reuse.

28. A method as in claim 1 wherein said gas passed in step a. to said medical process comprises a mixture of a first quantity of said decontaminated gas which has been used at least once in a prior such medical process and a second quantity of fresh said gas which has not previously been used in said medical process.

29. A method as in claim 15 wherein said hyperpolarized gas passed in step a. to s aid medical imaging comprises a mixture of a first quantity of said decontaminated gas which has been used at least once in prior such medical imaging and a second quantity of fresh said gas which has not previously been used in said medical imaging.

30. A method as in claim 1 wherein at least one of the steps therein is controlled by a microprocessor.

31. A method as in claim 15 wherein at least one of the steps therein is controlled by a microprocessor.

32. A method as in claim 1 further comprising filtering said contaminated gas through a filter to extract biological materials from said gas.

33. A method as in claim 32 wherein said filter has a biological filtration capability in the range of 1–10 nm.

34. A method as in claim 33 wherein said filter has a biological filtration capability on the order of 3 nm.

35. A method as in claim 1 wherein following decontamination of said gas in steps d–h, a process unit in which said decontamination has been conducted is isolated and regenerated for future decontamination, and thereafter said isolation of said unit is terminated and said unit as regenerated is made available for use in said method.

36. A method as in claim 35 wherein said isolation is by removal of said unit from incorporation in a decontamination process which performs said method, followed after regeneration by return to availability by reincorporation into said process.

37. A method as in claim 35 wherein said isolation is by bypassing of said unit in a decontamination process which performs said method, followed after regeneration by return to availability by such bypassing being terminated.

38. A method as in claim 35 wherein said process unit conducts said drying of step d.

39. A method as in claim 35 wherein said process unit conducts said contacting with a carbon dioxide absorbent of step e.

40. A method as in claim 35 wherein said process unit conducts said contacting with an oxygen absorbent of step f.

41. A method as in claim 35 wherein said process unit conducts said contacting with a nitrogen getter of step g.

42. A method as in claim 35 wherein said process unit conducts said reducing of step h.

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